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The Value of Waterway Enhancement in Christchurch A Preliminary Analysis

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Abstract

The Waterway Enhancement Programme was established by the Christchurch City Council as part of an ongoing commitment towards the sustainable management of tributary waterways throughout the city. Enhancement activities involve landscaping to emphasise the natural contours of the waterways, and planting native species to promote the establishment and maintenance of aquatic and bird life. Waterway enhancement activities provide increased opportunities for recreation and education, as well as drainage and water quality improvement services for the city. To the extent that they improve the habitat for native flora and fauna they also contribute to a valuable natural ecosystem that contributes to the quality of life for all Christchurch residents. The public good aspects of these benefits raise interesting policy questions regarding willingness to pay for waterway enhancement services, and the role of the public sector in their provision. In this study a simple statistical model is specified and used to explore the relationship between property values and proximity to a particular waterway enhancement site. Results indicate a statistically significant positive relationship between property values and waterway proximity, and suggest a positive willingness to pay for enhancement activities.

KEYWORDS

Nonmarket valuation, waterway enhancement, urban open spaces, hedonic pricing, locational rent, public policy.

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1. Introduction

The land under much of what is now the city of Christchurch was originally swampy wetland. To facilitate development, city planners modified a self contained land drainage system comprised of three small coastal rivers (the Avon, Heathcote and Styx) and their tributary systems. For 120 years prior to local government amalgamation in 1989, the management of the waterway system in Christchurch was the responsibility of the Christchurch Drainage Board, whose primary objective was to remove storm water from the district (Couling, 1993). Historically, therefore, the dominant concern in the management of Christchurch's waterways has been efficient drainage.

A number of factors since 1989 have led to a change in philosophy in waterway management, and in 1991 the Drainage and Waste Management Unit concluded that management should emphasise the natural attributes of waterways wherever practicable. Catalysts for change were factors such as local government reform, the passage of the Resource Management Act, increasing environmental awareness of the general public, and the increasing cost of managing and extending the existing drainage system (Couling, 1993). This change in philosophy has led to the establishment of the Waterway Enhancement Programme (WEP) for the long term improvement of the tributary waterway system.

The WEP specifically involves tributary waterways that have been classified as utilities or environmental assets. The broad aim of the WEP is to manage Christchurch's waterways in a sustainable manner, consistent with the philosophy of the Resource Management Act. Although each waterway has its own unique characteristics, enhancement activities generally involve emphasising the natural contours of the waterways and planting native species to promote the establishment and maintenance of aquatic and bird life. The enhancement alternative is in stark contrast to the previous drainage philosophy, which favoured either piping or straightening surface watercourses, which were generally bounded by man-made materials and bordered with minimal vegetation.

Waterway enhancement activities provide increased opportunities for recreation and education, as well as drainage and water quality improvement services for the city. To the extent that they improve the habitat for native flora and fauna they also contribute to a

valuable natural ecosystem that contributes to the quality of life for all Christchurch residents. Economic theory suggests that the value of adjacent properties will reflect some of the benefits of waterway enhancement activities. The objective of this study is to explore the relationship between property values and waterway enhancement activities, and draw some preliminary conclusions about Christchurch residents' willingness to pay for the services of the Waterway Enhancement Programme.

The ensuing subsections provide background information on tributary waterways in Christchurch. Section 2 reviews the concept of economic value within the context of waterway enhancement benefits. A review of the literature on valuing open spaces in urban areas is presented in Section 3, and used to develop the simple statistical model outlined in Section 4. Results of the statistical analysis are presented in Section 5, and compared to *a priori* expectations and conclusions drawn from previous studies. The policy implications of this preliminary analysis are explored in Section 6, and the study concludes with suggestions for future research.

1.1 Tributary Waterways in Christchurch

For management purposes Christchurch waterways have been classified as either rivers or tributary systems, depending upon the size of the waterway and the nature of its banks and margins. There are currently 90 kilometres of rivers, and almost 300 kilometres of tributary waterways in Christchurch. Traditionally these tributary waterways have been piped and buried as the city developed. Piping is an hydraulically efficient means of transporting water, allowing dense property development to take place extremely close to existing waterways. Unfortunately piping destroys the recreational or amenity value that may be associated with the waterways, and greatly modifies existing wildlife habitats (Watts, 1994).

Since the establishment of the WEP, improvement options for the tributary waterways include piping and enhancement. While there are advantages and disadvantages associated with both options, a number of factors combine to make enhancement an extremely attractive alternative. On a discounted basis, for example, enhancement is a lower cost option at approximately $165 per metre compared to $540 per metre for piping. In addition to being aesthetically pleasing, therefore, enhanced waterways provide flood protection for their

catchment areas at a lower discounted cost than piping. The natural waterways also offer the potential to improve the quality of the water that percolates into the underground aquifers or discharges into the sea.

There are disadvantages associated with enhancement as well. Open waterways can provide a breeding ground for nuisance insects, and a source of organic odour that some people find unpleasant. There has also been concern over the safety of open waterways. Although historical records show that there are very few vehicle accidents involving open waterways, there is a perception that unfenced bodies of water may pose a safety threat to children. Finally, open waterways can collect debris that imparts an extremely untidy look to the area.

Spending on enhancement activities totalled $200,000 in 1994/95, compared to $1,180,000 for piping. The advantages mentioned above, however, have prompted a proposal from the Water Services Unit of the Christchurch City Council to shift the expenditure on Land Drainage Waterway Enhancement from the current 85:15 in favour of piping to 65:35 through time. The vision of the current unit is to create a network of linear parks from the sea to the Port Hills and rural outskirts. This 'green corridor' will provide a key linkage between natural habitats and an important recreational amenity for Christchurch residents. The programme will also provide a guarantee that the waterway environment is improved and maintained for future generations, as required by the RMA.

1.2 Property Rights and Christchurch's Waterways

Much of the tributary waterway system in Christchurch lies within private residential properties. Historically, therefore, landowners have been responsible for erosion protection and maintenance of bank stability along smaller waterways. Residential development on the Port Hills, for example, has been allowed to occur very close to watercourses which generally pass through private lots (Couling, 1993). The drainage solution to cope with the bank erosion which inevitably occurred has been piping, which satisfied engineering criteria and alleviated many of the nuisance factors mentioned above. Unfortunately these benefits involved a high capital cost, and were achieved at the expense of the natural aesthetic quality of the waterway.

The 1995 Christchurch City Plan alters the property rights to undeveloped land adjacent to waterways by stipulating a series of setbacks which vary from 5 to 30 metres. Any activity involving filling, excavating or building within the setback zones is at the discretion of the Council, and requires a resource consent. This feature of the city plan emphasises public access to waterways, and facilitates improvement of tributary systems which may otherwise have been piped.

1.3 Public Good Aspects of Christchurch's Waterways

Improvements proposed by the Waterway Enhancement Programme exhibit two important characteristics traditionally associated with public goods: nonexclusion and nonrivalry. *Nonexclusion* implies that it is impossible, or at least very costly, to exclude people from enjoying the amenities provided by a particular good. Although many of the waterways in Christchurch adjoin private residential property, a high degree of public access means that members of the general public can enjoy outdoor activities by the water's edge. The setback provisions in the new City Plan will also enable the Council to improve and maintain undeveloped land adjacent to existing waterways for the enjoyment of the general public. The consumption of a *nonrival* good by one individual does not diminish the quantity or quality of consumption available to another individual. This is in stark contrast to private goods such as food items, where one person's consumption precludes consumption possibilities by anyone else. The waterways will most likely exhibit the characteristic of *congestability*, which allows nonrival consumption up to a certain 'threshold' of users, and diminished enjoyment for all concerned once the public area becomes over-crowded.

Economic theory suggests that the private sector will under-provide goods with the above mentioned public good attributes. The challenge from a policy perspective is therefore to determine the level at which these goods should be provided. While it is acknowledged that the Council may have multiple objectives, models based on economic theory can provide valuable information upon which to base difficult decisions involving the allocation of scarce public resources. One tool commonly used by policy analysts to aid decision makers who spend public money is Cost-Benefit Analysis (CBA). Using a carefully constructed CBA, the analyst hopes to identify ***potential Pareto improvements***, or policies in which at least one person could be made better off from a change in the provision of a pubic good without

making any other person worse off. A situation would fit this criterion if it provided sufficient gains to allow the "losers" to be compensated by the "winners," who would have remaining gains (Johansson, 1991). CBA can also be used to compare rates of return for differing programmes or projects which compete for limited public resources, all of which may represent potential Pareto improvements.

The potential Pareto criterion has been controversial in practice because compensation is generally not received by the losers and as a result there can be a large number of people disadvantaged while only a minority experience a large gain. However, use of the potential Pareto criterion has been justified by the assumption that governing bodies can impose programmes which compensate for undesirable distributional effects (Mitchell and Carson, 1989). In addition, the analysis is often a useful exercise in itself as it results in a formal report, which then opens the whole process up to possible criticism, discussion, revision and improvement.

Given that the resources controlled by any public body are limited, the money that is spent on projects and programmes has important opportunity costs. Tradeoffs must be made, and it is fundamentally important to know what is being traded off against what. Informed decisions, therefore, require knowledge of the value of environmental assets. One difficulty associated with fully analysing programmes such as the WEP is that their environmental benefits can be extremely difficult to quantify. In the past this fact has disadvantaged expenditures on environmental improvements. Fortunately economists and statisticians have developed a number of techniques designed to value changes in the provision of environmental amenities.

2. The Concept of Economic Value

According to economists, a good has value if someone is willing to give up valuable resources for it. Although this is admittedly an anthropocentric concept of value, it does not deny that a good may be valuable for reasons that are unrelated to human use. One basis for attempting to place a monetary value on the improvements provided by the WEP is to help justify the commitment of public funds to that particular area. As mentioned above, an improvement can be justified on economic grounds provided that the benefits it generates for society are greater

than the costs. Since costs and benefits must be measured in the same units, and since costs are typically measured in dollars, a monetary measure of the benefits is derived.

2.1 Categories of Economic Value

Economic values have been defined in a variety of ways by a number of economists. Following Mitchell and Carson (1989) goods may have use and/or nonuse values. ***Use*** values include all current direct and indirect ways in which people can make physical use of a public good. Using the WEP as an example, the programme has ***direct use*** benefits in so far as it provides a pleasant environment for water sports and picnic activities. The programme will also provide drainage and flood protection for inhabitants of the city, which implies significant ***indirect use benefits***. In addition, the enhanced waterways provide habitat for plant and animal life which supports such activities as bird watching and botanical outings.

The recognition of ***nonuse values*** implies that people do not have to visit a public amenity to benefit from its maintenance or improvement. These values are regularly expressed by individuals in the form of contributions to environmental groups and favourable votes on environmental issues which do not directly affect the individual casting the vote. Nonuse benefits of the WEP include the enjoyment that an individual may derive from current ***vicarious consumption*** activities of people who may or may not be known to them. They also include ***stewardship*** values which may stem from knowing that the enhanced environment exists to provide a natural habitat regardless of whether any humans visit the sites. Stewardship benefits of the WEP also include ***bequest*** values which exist because of the knowledge that current provision of the enhanced waterways will ensure that the interests of future generations will not be compromised.

Table 1
Economic Values Associated with the Waterway Enhancement Programme

Use Values	
Direct Use	• recreational activities on waterways • picnic activities at waters edge
Indirect Use	• provision of drainage for city • provision of habitat for flora and fauna • improvement of water quality
Nonuse Values	
Vicarious Consumption	• satisfaction associated with other's enjoyment of the enhanced waterways
Stewardship	• satisfaction associated with the knowledge that future generations will enjoy amenities provided by enhanced waterways • satisfaction associated with knowing enhanced waterways exist, unrelated to any present or potential human use

Source: Adapted from Mitchell and Carson

2.2 Measuring Economic Value

It has been mentioned above that an item has economic value so long as someone is willing to pay to acquire it, or conversely, requires compensation to part with it. As long as a market exists for a particular good, the price that evolves from the interaction of supply and demand generally provides a reasonable indication of its marginal value. Both buyers and sellers improve their welfare by taking advantage of the opportunities for exchange, with a sale being agreed upon so long as the price offered is at least as great as the value of the good being sold. In a competitive market the total willingness to pay for a particular good can be calculated mathematically as the area under the demand curve. The net benefit to consumers (referred to as consumers' surplus) is represented by the area under the demand curve, but above the price line. In other words, the amount paid must be subtracted from the total willingness to pay to arrive at a net benefit. The measurement of economic benefits therefore traditionally involves

the statistical estimation of a demand curve, which in turn requires the collection of market data representing transactions between buyers and sellers.

The above discussion of value indicates that there are many goods that people value, but for which no market exists. Alternatively, individuals may value a particular good for reasons that are not connected to their own purchase and use. Since environmental improvements such as those provided by the WEP are not traded in ordinary markets, their values must be inferred indirectly from consumer purchases of related commodities, or directly from experimental methods. The three techniques used most commonly to estimate the value of goods not traded on conventional markets are the Hedonic Price (HP) approach, the Travel Cost Method (TCM), and the Contingent Valuation Method (CVM). The conceptual link to traditional economic theory is that while a demand curve is not observable if there is no market for a commodity, there still exists a latent demand that can be estimated through other means. The literature review presented in the next section indicates that while a number of innovative non-market valuation techniques have been applied to urban parks, most of the previous work has explored the link between property values and willingness to pay for open spaces.

3. Previous Work on Valuing Open Space in Urban Areas

In an early paper on urban park valuation, Knetsch (1962) observed that the important social values associated with urban parks are unlikely to be expressed explicitly in the market place. Knetsch identified two components of value, one of which amounts to willingness to pay for park proximity, and would be capitalised into the value of houses which are close to public parks. The other component reflects benefits enjoyed by users of park amenities. Knetsch's paper was a theoretical discussion rather than an empirical study, but he did suggest that property differentials may be used to estimate the first component of value, and the travel cost method may capture user values. While the relative contribution of each of these components of value is an empirical question, Knetsch stressed that estimates of these values can not be summed without the risk of double counting. Knetsch further postulated that most of the value of small neighbourhood parks would be captured using a land value approach, while user values may be more important for large regional parks.

Kitchen and Hendon (1967) used simple correlation analysis to test the hypothesis suggested by Knetsch's theoretical paper: that properties close to urban neighbourhood parks are of greater value than properties located further away from park amenities. These authors experimented with total assessed value, assessed value of land, and sale price as proxies for property value. The 'zone of influence' defining park proximity was defined as a 2.5 block area, or five parcels of land surrounding the park. Their results indicate a statistically insignificant *positive* correlation between distance from the park and total assessed value, as well as distance and sales price. The correlation coefficient between assessed land value and distance from the park, however, indicates a small but statistically significant negative relationship between land values and distance from the park. These authors defended the last correlation as being the most representative because land is a homogeneous commodity whose value does not include non-uniform structural improvements. The results of this simple bivariate linear analysis do not, however, conclusively support their original hypothesis.

In an attempt to calculate the benefits of urban water parks, Darling (1973) compared estimates resulting from two separate methodologies. Darling used multiple regression to test the hypothesis that the value of property attributed to park amenities is a decreasing function of distance. Sales price and assessed value were used as proxies for value, and various structural characteristics of the house and neighbourhood were included as explanatory variables. The zone of influence for Darling's study was defined as property 3,000 feet from the shore. Capitalised property values resulting from the regression analysis were compared to consumer's surplus estimates obtained through interviews. Interviews were limited to people living within the zone of influence, so the consumer's surplus estimates were alternative to, not additive to, the land value estimates. Results indicated that people are willing to pay for park amenities, but the property value technique consistently indicated a substantially larger willingness to pay. Analysis of three separate water parks implied that the magnitude of the willingness to pay will also depend on park facilities.

Weicher and Zerbst (1973) focused exclusively on obtaining estimates of what they defined as the externalities associated with neighbourhood parks. These authors hypothesised that the benefits associated with pleasant views of open space will be capitalised into the values of property that is specifically adjacent to neighbourhood parks. Multiple regression analysis was used to test this hypothesis, and to estimate the value of the park externalities. When sales price was regressed against structural characteristics of the house, year of sale and three

locational dummies, the authors discovered that the sign of the externality depended critically upon the way the property bordered the park. A positive externality was associated with a pleasant view of open space, while a negative externality was associated with a back boundary or a view of heavily used sports/recreational facilities. These results are consistent with those of Darling's: local residents' willingness to pay for urban park amenities depends upon the nature of the facilities provided.

Using similar methodology, Hammer, Coughlin and Horn (1974) argue that land values may capture accessibility/active use values as well as benefits associated with scenery and wildlife numbers. They used multiple regression to test the hypothesis that the 'location rent' associated with park proximity is a decreasing function of distance from the park. More specifically, the sale price of properties within 2 000 feet of an urban park in Philadelphia was regressed against explanatory variables which captured structural and locational characteristics of the houses in question. Proxies for park proximity included straight line distance and distance along public walkways, both measured in feet. Results indicated that proximity to the park was a significant indicator of value, and that the locational rent did indeed decline with distance from the park.

Correll, Lillydahl and Singell (1978) also hypothesised that residential property values decline with distance from a public amenity, but their attention was focused on the benefits associated with greenbelts in Boulder Colorado. These authors employed multiple regression analysis to isolate the capitalised value of the externalities generated by the public land, which controlled development and helped to preserve the city's scenic mountain backdrop. Sales prices of properties within 3 200 feet of the greenbelt were regressed against the walking distance to the greenbelt, as well as various structural and locational indicators. Results indicated that distance from the greenbelt had a statistically significant, negative influence on the sales price. The authors also noted that the increase in property taxes attributable to a particular greenbelt area could potentially pay for the purchase price of the land set aside for public use, making greenbelts attractive from a cost benefit perspective.

The central focus of a similar paper by Li and Brown (1980) was to test the impact of a variety of micro-neighbourhood variables on housing values. Their multiple regression model included twenty-eight independent variables representing structural and site characteristics of the house, neighbourhood characteristics, public services, accessibility to the central business

district, and micro-neighbourhood characteristics such as visual quality, noise pollution, and proximity to natural features such as rivers and the ocean. Results indicated that the structural characteristics of the house were the most important indicator of sales price, but that proximity to the ocean and rivers was also significant. The sign of the coefficient associated with these variables implies that sales price declines as distance to oceans and/or rivers increases.

Schroeder (1982) used multiple regression analysis to test the general hypothesis that people are willing to pay more for property in a community with relatively good park and recreational facilities than for a similar property elsewhere. To measure the quality of park and recreational services, Schroeder specified per capita expenditure on park and recreation services, and acreage of parkland per 1 000 people. The data included sales price of the property, as well as 14 independent variables reflecting structural and locational characteristics of the houses. The data set was split prior to analysis so that any significant results could be verified. Results indicated that there was no significant relationship between property value and either per capita expenditure on parks or acreage of parkland per 1 000 population. While Schroeder was testing a slightly different hypothesis, his results do not provide support for the theory that quality public parks and recreation services improve property values.

In a theoretical discussion comparing various methodologies for measuring the benefits of urban parks, Allen, Stevens and More (1985) warn that property value studies may under estimate the value of parks because they do not capture benefits enjoyed by distant users. Although the authors suggest that the travel cost method may be used to estimate 'distant user benefits', they acknowledge that people may not travel very far to visit small urban parks. The authors argue that hedonic pricing studies capture the benefits of a park as perceived by purchasers of nearby properties, which include both visual amenities or externalities and user benefits. The travel cost method, on the other hand, reflects only user benefits. Estimates from these two methodologies clearly can not be summed without double counting.

In an empirical study of four urban parks in Massachusetts the same authors combine the property valuation technique and personal interviews to statistically estimate the total benefits of urban parks (More, Stevens and Allen, 1988). Hedonic pricing was used to capture user benefits and externalities for nearby residents, while interviews were conducted to determine user values for those who lived outside the 2 000 foot zone of influence. As opposed to

conducting a contingent valuation survey, however, a daily user fee of $1.00 was assigned to represent the willingness to pay for distant users. The hypothesis tested with the hedonic pricing model was that the price differential attributable to park facilities will vary with the level of amenities provided. Sales price was regressed against various indicators of housing characteristics and distance from the park for properties within the 2 000 foot zone. Following Correll, Lillydahl and Singell, proxies for distance included straight line and public road to nearest access point. Results indicate that park proximity does have a statistically significant influence on property value, and that the location rent does vary with the amenities that the park provides. In addition, the authors determined that in all four cases the benefits outweighed the cost of operating each park, suggesting a positive net benefit for urban parkland. Unfortunately the opportunity cost of the land was not included in their analysis, so their study can not be considered a rigorous cost benefit analysis.

Lupi, Graham-Tomasi and Taff (1991) also used regression techniques to examine the extent to which property values can be used to measure the non-market benefits of urban wetlands. These authors regressed sales prices against site specific, structural and environmental variables. Acres of wetland per survey section was used as a proxy for the amount of wetland in a particular 'neighbourhood'. A similar variable indicating the number of 'lake acres' per survey section was used to control for the amount of lakes in a region. Additional environmental variables included proxies for lake adjacency and adjacency to the Mississippi River. Results indicate that lakes and wetlands have a significantly positive effect on property values, although the marginal willingness to pay for additional wetland acreage becomes negative at high levels of existing wetlands. In addition, the willingness to pay for marginal changes in wetland acreage per section is greater in areas with fewer acres of existing wetlands, and areas with higher density housing.

In a subsequent paper Doss and Taff (1993) use a more sophisticated data set to capture the relative value placed on four different types of wetlands, from very forested to very open. Doss and Taff use regression analysis to test the relationship between property values and proximity to wetlands. The 1990 assessed value was used as the dependent variable, and distance from each property to the edge of the nearest wetland was used as the proxy for distance. Their results indicate a statistically significant relationship between property values and distance, with open and scrub/shrub wetlands receiving a higher ranking than forested or emergent vegetation wetlands.

Although the results of this wide range of studies are not entirely conclusive, they do suggest that there is a high degree of willingness to pay for publicly provided open spaces. In addition, they highlight an important link between property values and the non-market benefits associated with open space amenities. Not surprisingly, the magnitude of the willingness to pay for urban parks appears to depend upon the facilities provided and the precise spatial relationship between the property and the park in question. Where it was available, actual sales price was preferred to assessed value as a proxy for price, and distance along public roads yielded more desirable results than linear distance as a distance variable. Unfortunately data limitations severely limited the choice of variables in the current application.

4. Methodology

The discussion on economic value presented in Section 2 suggests that, while people may value the benefits associated with waterway enhancement in Christchurch, there is currently no direct market which allows them to express their preferences. Nonmarket valuation techniques must therefore be used to elicit preferences directly, or infer them from behaviour in a related market. The literature review presented in Section 3 clearly indicates that the nonmarket valuation technique most commonly applied to urban park valuation involves the analysis of property market price differentials. Proximity to open spaces such as urban parks and waterways implies a greater potential to benefit from the services that these amenities provide. According to economic theory, if the land adjacent to a park is in short supply, its price will increase to reflect the capitalised value of the benefits of the park. In equilibrium, therefore, property price differential should approximate the value of the park benefits.

4.1 The Model

Data limitations preclude the specification of a sophisticated hedonic pricing model for this empirical application. It is possible, however, to draw some preliminary conclusions about the amount that people are willing to pay to live near an enhancement site using a very simple linear model applied to the data that is available. For this preliminary analysis a simple linear

regression model is specified, where sales price is hypothesised to be a function of house-specific characteristics, and proximity to the waterway. More specifically:

(4.1) $SP = \beta_0 + \beta_1 P_1 + \beta_2 P_2 + \beta_3 SIZE + \varepsilon$

where SP represents sales price, P_i are proximity variables, SIZE indicates the size of the section or the floor area of the dwelling, and β_i are parameters to be estimated. The random error term (ε) is assumed to be normally distributed with a zero mean and constant variance across all observations.

While a more sophisticated model supported by a larger data set would be preferred, the results of this simple statistical model should provide enough information to begin making inferences about the economic value of waterway enhancement. A positive willingness to pay for proximity to waterways, providing it can be appropriated by developers, suggests that there may be some private incentive to provide enhancement services. Whether the incentive is sufficient for a functioning market will depend upon the costs of providing these services relative to the increase in property values.

4.2 Data and Statistical Hypotheses

The empirical application involves property in the vicinity of Corsers Stream, an enhancement site initiated in a new suburb in northeastern Christchurch in the early 1990's. WEP activities include widening and adding curvature to the existing stream banks to give the watercourse a 'meandering' effect. The banks have also been landscaped with several native species, which creates a park-like setting and attracts waterfowl and aquatic life. There are several aspects of this site that make it appropriate for the present analysis. Corsers Stream was one of the first sites to be enhanced, so the surrounding property values have had some time to reflect enhancement activities. The housing stock in the area is also relatively homogeneous, making the omission of alternative housing characteristic variables a less serious problem. Finally, some of the development of the surrounding suburb took place at the time the waterway was being enhanced, allowing architects to incorporate the stream into their plans.

While the literature review uncovered a vast array of housing characteristics influencing sales price, severe data restrictions limit our choices to floor area of the dwelling or section size, both expressed in square meters. While this lack of choice may introduce specification bias, it is interesting to note that floor area is often the most significant explanatory variable in multiple regression models employing a much larger selection of independent variables. Price and area data were collected from Valuation New Zealand. Sales price is the actual transaction price, adjusted for inflation with an index of housing prices. Floor area and section size are expressed in square metres. Proximity is incorporated with three dummy variables: one for properties adjacent to Corsers Stream, one for properties on the same block but not adjacent to the stream, and one for properties located across the street. The third dummy was excluded from the statistical analysis, so the coefficients on the remaining proximity variables can be interpreted as the location rent associated with waterway enhancement services.

The specific hypotheses to be tested are:

1. Ho: $\beta_1 = 0$, and

2. Ho: $\beta_2 = 0$.

In other words, houses or sections that are closer to an enhanced waterway sell for more than distant properties. In addition, we would expect that $\beta_1 > \beta_2$, or that there is more locational rent associated with adjacent properties.

5. Results

Results of two regressions are reported below (Table 2). In the first equation sales price is hypothesised to be a function of proximity to the waterway, and the floor area of the dwelling. The data set for this regression consisted of 45 observations. The adjusted R^2 indicates that nearly 70% of the variation in sales price is captured by the explanatory variables, which is a

fairly good result given the limitations associated with the data set. P-values associated with the dummies are 0.022 and 0.109 for the adjacent and the same block variable, respectively.

The parameter values in equation 1 suggest that, holding floor area constant, adjacent houses sold for $34,721 more than properties located across the street from Corsers Stream. Similarly, houses on the same block as Corsers stream sold for $13,696 more than distant properties. These values represent 15.71% and 6.2% of the mean of the independent variable, respectively. These figures compare favourably to previous results by Weicher and Zerbst (1973), who report that houses with a scenic view of an urban park sold for approximately 7% more than properties one block away. More recently, Lupi, Graham-Tomasi and Taff (1991) calculated that lakeside houses sold for $41,000 more than houses which were not adjacent to a lake. This figure represents nearly 50% of the value of the independent variable[1].

Table 2
Regression Results

Equation 1: Independent variable: Sales Price				Adj R^2 = 0.69
	Constant	Adjacent	Same Block	Floor Area
Parameter Value	62,176	34,721	13,696	779
t statistic	(3.76)	(2.38)	(1.64)	(9.61)
Equation 2: Independent variable: Sales Price				Adj R^2 = 0.13
	Constant	Adjacent	Same Block	Section Size
Parameter Value	65,266	6,896	3,471	19.58
t statistic	(7.84)	(2.31)	(1.69)	(1.91)

A comparison of properties adjacent to Corsers Stream with those located further away led us to suspect that the estimates from the first equation may reflect housing characteristics as well as waterway proximity. We therefore specified the second equation, which included only sections that had not been improved. In this equation the sales price reflects only the value of

[1] There was a much higher standard deviation associated with housing prices in their data set

the land, which is hypothesised to be a function of proximity to the waterway and section size. Although much less of the variation in the independent variable can be attributed to the explanatory variables, the proximity variables are still statistically significant in this specification. Parameter values indicate that sections adjacent to Corsers Stream sell for almost $7,000 more than sections across the street. Similarly, there is a $3,472 premium for sections on the same block as the stream. These results provide corroborative evidence for the casual observations of one local realtor, who estimated that properties adjacent to Corsers Stream sold for an additional $5 000.

6. Policy Implications

Despite severe data limitations, this preliminary analysis has established a link between property values and waterway enhancement services. In particular, the existence of an attractively enhanced waterway has a significantly positive impact on property prices in a northeastern suburb of Christchurch. This observation raises two interesting policy questions. The first has to do with the magnitude of the benefits of Corsers stream. A related policy question is whether private individuals can be expected to provide waterway enhancement services. In other words, are the benefits enjoyed by people living in close proximity to a waterway 'appropriable' by a developer who must choose between piping and enhancing waterways prior to development, or by private individuals seeking to improve the value of their property?

With regards to the first question, Equation 1 implies a location rent of $34,721 per property for houses adjacent to Corsers Stream, and $13,696 per house for properties on the same block. Amortised over a 50 year time horizon using a discount rate of 6.5%, these figures represent an annual benefit of $2,358 and $930 per property, respectively. Multiplying the annual benefits by the number of houses adjacent to (20) or on the same block as (51) Corsers Stream yields an aggregate benefit of $94,600 for those living close to Corsers Stream. It is important to recall that these figures do not reflect the use or non-use benefits enjoyed by more distant residents.

Data limitations did not allow us to control for housing characteristics other than the size of the dwelling. It is quite likely, however, that houses near the waterway are more desirable due to factors such as unique architectural design or the quality of the building materials. If this is the case, the statistical analysis will attribute too much of a premium to waterway proximity. It can therefore be argued that the second equation may provide a more accurate reflection of the benefits of waterway enhancement. A similar aggregation procedure applied to the coefficients from Equation 2 implies an annual benefit flow of $21,393 for Corsers Stream. Once again, this figure reflects only part of the total economic value of the enhancement activities at Corsers Stream.

While the Waterway Enhancement Team should find these results encouraging, the figures do not imply that waterway enhancement is the most socially productive use of the land. The regression coefficients indicate a positive willingness to pay for waterway proximity. They do not reveal precisely which of the many waterway enhancement services are particularly valuable. Similar results may have been obtained, for example, if the open space had contained extensive playground equipment for children. In addition, the results are indicative only of the benefits associated with a well enhanced site located in a relatively affluent suburb, and should not be extrapolated to all waterway enhancement sites.

It is difficult to provide a definitive answer to the question of whether private individuals can be expected to provide waterway enhancement services. The results of this study do indicate that enhancement activities have a significantly positive impact on adjacent properties. Enhancement services will therefore provide a return to those who own the property at the time of enhancement. Unfortunately we can not determine whether there is sufficient incentive to prompt developers to choose enhancement over piping, or to encourage the improvement of waterways in developed areas, without more information on the full economic costs of enhancement. It is also important to remember that waterway enhancement provides subtle benefits in the form of contiguous wildlife habitats that are very diffuse and not fully reflected in adjacent property values. Under these circumstances economic theory suggests that a competitive market will underprovide waterway enhancement services. This raises the contentious question of the extent to which private versus public funds should be used for enhancement activities.

7. Limitations and Suggestions for Future Research

This exploratory study into the economic benefits of waterway enhancement services in Christchurch reveals a statistically significant positive relationship between property values and waterway proximity. Although these results indicate that Christchurch residents do value the services provided by the Waterway Enhancement Programme, data limitations preclude a precise understanding of the complex relationship between property value and waterway proximity. It is not clear, for example, which enhancement features are particularly valuable in the sense that people are willing to pay relatively more for them. It is also an open question as to whether socio-economic status has any influence over the level of preference towards waterway enhancement services. In addition, the results reveal very little about the value that distant residents place on enhancement activities, other than suggesting that the locational rent declines with distance from the waterway. This last question is particularly important, because the existence of diffuse externalities which can not be appropriated by private individuals provides justification for public sector involvement in the provision of waterway enhancement services.

The Waterway Enhancement Team is in the process of restoring a vast array of tributary waterways throughout Christchurch. Through time the activities of the WEP will therefore include a wide variety of services across a diverse natural and socio-economic landscape. This rich source of information, combined with the comprehensive GIS database maintained by the Christchurch City Council, should alleviate many of the limitations associated with the current data set and support the future development of more sophisticated models.

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